6.4.1 What's in the Water and Who's in the Water Storyline Overview

Anchor Phenomenon: Local Watershed picture/s headwaters, middle, and lower sections, lakes (if possible samples of water from where pictures were taken)
http://streamsidescience.usu.edu/photo-video (Print and laminate photos from this link or internet river images if you are unable to access water sources for samples and pictures)

Big Question: How and why do living and nonliving water quality factors in a waterbody change in relation to one another?

Student Performance Expectation:
6.4.1 Analyze data to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. Ask questions to predict how changes in resource availability affect organisms in those ecosystems. Examples could include water, food, and living space in Utah environments.
Math Standard 6.EE.9
Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

Dominant DCI
LS2.A: Interdependent Relationships in Ecosystems
(Evidence Statement:
https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS%20LS2%20Evidence%20Statements%20June%202015%20asterisks.pdf (copy and paste this link into your browser if link doesn't work directly.)
● Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
● In any ecosystem, organisms and populations with similar requirements for food, water, oxygen or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
● Growth of organisms and population increases are limited by access to resources.

Dominant CCC's : Cause and Effect, Patterns, Stability and Change in Systems

Dominant SEP's : Asking Questions and Defining Problems; Planning and Carrying out Investigations; Analyzing and Interpreting Data

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Storyline Overview			
Title: CCC/SEP: Time:	What are Students Doing? (This should match your SEP)	What Disciplinary Core Idea (DCI) understandings should students get from this experience?	Questions to guide students through their science experience
Episode 0- Phenomena <u>Water Investigation</u> CCC: Cause and Effect SEP: Asking Questions and Defining Problems Time: 45 minutes	*Gather:* Students observe and analyze pictures of water ecosystems and water samples (if available) to identify what types of things are in and/or near the water. *Reason:* Students re-organize the classification of factors recognizing that many of the observed factors, like leaves, stones, sticks, plants, exist both in and near the water. Students engage in argument to define new classifications. Teacher guides students towards the living/nonliving classification.	*Gather:* Factors in the water are plants, fish, bugs, algae, rocks, sediment, gravel, riffles, pools, oxygen, nutrients (nitrates, phosphates) acidity. Factors near the water are trees, shrubs, and other plants, groundcover, soil, land uses- farming, industry, residential, rocks, leaves, animals, birds, bugs. *Reason:* Students will need to recognize that these factors can be categorized into living and nonliving factors	*Gather:* What kinds of things are in the water at these locations? Why does the water and its surroundings look different at the different locations? Have you noticed that some of the factors identified are both in and near the water? *Reason:* Can you identify a way to categorize these factors so that they are separated into two distinct groups and there is no overlap? What properties can be used to divide factors into two groups?

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	Communicate: Students re-organize their lists and circle factors on their list that they predict will influence one another within a water system.	*Communicate:* See Streamside Science resource pages for reference to how factors may influence one another. https://extension.usu.edu/waterquality/files-ou/Watershed-information/Stream-Side-Science.pdf	*Communicate:* What are the potential effects of nonliving things on living things? and/or living things on nonliving things in the river and lake ecosystems? How do these interactions effect the organisms in the water ecosystem?
Assessment for Phenomena	Students write down two factors in or near the water that they have discovered. Students explain if the factors are living or nonliving. Students then predict how these factors may interact or influence one another within the river system explaining their reasoning. Students will compare these predictions to the data they collect.		
Episode 1: Testing Water Parameters CCC: Cause and Effect SEP: Planning and Carrying out an Investigation Time: 45-60 minutes	*Gather:* Student groups brainstorm ways to measure water parameters. This can include only water chemistry (nonliving factors) and/or biological monitoring (macroinvertebrates, algae) *Reason:* Teacher matches student measurement ideas, like color intensity or mass to a pH, nitrate, or DO test, or length to the turbidity test that uses a ruler. Students read and record background information and instructions specific to	*Gather:* Students with teacher's guidance, will recognize that dissolved oxygen and nitrogen tests can be matched to student measurement ideas related to color or mass (mg/L). Color comparisons are also used for pH tests. Turbidity tubes incorporate rulers. Degrees, digital readings measure temperature. Species of bugs, algae are collection tests that use classification keys, tallies, percent, and averages. *Reason:* See links to Streamside science for instruction and resource sheets. https://streamsidescience.usu.edu/lessons/5-12/whats-in-the-water/ https://streamsidescience.usu.edu/lessons/5-12/who-lives-in-the-water/index	*Gather:* How can river ecosystem factors be measured to monitor the health of the river? *Reason:* What are the specific procedures used for measuring the living and nonliving factors in the water body? Why are these parameters important to measure?

	the test they have been assigned. Students research and record how to measure the parameter, and why the parameter is important. *Communicate:* Individual experts from each group present to the class what the factor is, how it will be monitored, the significance of the test, and the Utah standard for the test. Class records notes on student data sheet used for field data collection.	*Communicate:* Students learn from one another what the parameters are that they will be testing. They teach each other the process for collecting the sample. Students explain the significance of the Utah standard for each parameter and identify what happens to environmental factors if measurements fall above or below the standard.	*Communicate:* What is the parameter? How is the factor measured? Why is this factor important to measure? What is the Utah standard? What happens to organisms if the measurements are above or below the Utah Standard?
Assessment Episode 1	Students can either write this in their journal or groups can be randomly chosen to present to the class one of the measurement parameters. Students should describe 4 things: • Explain what the factor is • Explain why this factor is being measured. • Explain the procedure for measuring the factor accurately. • Predict what the measurement should be, based on Utah Standards.		
Episode 2: <u>Field Data Collection</u> CCC: Patterns, Stability and Change of	*Gather:* Students are making observations and recording field data on student sheets.	*Gather:* Students check that their recorded measurements are put in the correct place on the field data chart.	*Gather:* Is the air temperature measurement being recorded in the right place on the chart? Are both water and air temperature being recorded in and °F? Have multiple tests been carried out to ensure accuracy?

Systems SEP: Asking Questions and Defining Problems Time: 1 hour, half day, full day depends on where samples are taken and on transportation.	*Reason:* Students are observing the area around the water ecosystem asking questions to determine relationships between water parameters and surrounding land uses. *Communicate:* Students are sharing observations, asking questions making predictions with one another and teacher/water professional volunteers.	*Reason:* Students observe relationships between living and nonliving parameters. Examples may include oxygen and temperature relationships with riffles compared to no riffles, temperatures of shaded cooler areas compared to sunny warmer areas. Pollution intolerant macroinvertebrates may be found in cleaner water, more tolerant species in less clean water. Possible connection with fertilizer sources and algae concentrations. *Communicate:* Students are collecting inferences, examples being; muddy water has higher turbidity which may or may not be related to a weather event. Higher oxygen levels may be found where more riffles exist or where plants are photosynthesizing in sunlight. Colder temperature may be in shady areas vs. sunny areas.	Are students recording their observations related to the areas surrounding the water? *Reason*: What conditions exist when oxygen is higher? Lower? How does stream bank stability effect turbidity? Are there conditions around the stream or lake that influence temperature? Turbidity? Amount of algae? *Communicate:* If data is collected over time- How does the weather or season impact water quality factors? What areas along the river match Utah standards? Why or why not?
Episode 2 Assessment	Students are doing a self-assessment. They are making predictions based on observations and land use conditions then determining if those predictions are accurate.		
Episode 3: <u>Water Data Graph Analysis</u>	*Gather:* Students review prepared water graphs; temperature, pH, dissolved oxygen and temperature. Students use BSCS I^2	*Gather:* Students recognize shapes the graph makes i.e. hills, mountain shapes, the letter A. They read the labels. They identify the number range. They notice how the lines rise and fall.	*Gather:* What patterns do you see on the graph? Can you describe the shape of the lines/columns? What is written on the side of

CCC: cause and effect, stability and change SEP: Analyze and Interpret Data Time: 45-60 minutes	approach to write what they "see" on the graph. *Reason:* Students make inferences related to "I see" statements by adding an "it means" statement. *Communicate*: Students combine their "I see" statements with their "It means" statements to create captions that describe the water graphs' data relationships.	*Reason:* Students are interpreting data to infer what their "I see" statement means. For example, I see the temperature goes up more slowly in the spring than the fall. This could mean that weather or snowmelt was colder in the spring as compared to the fall. *Communicate:* On the temperature and pH graphs students explain how and when the graph goes up and down. On the Oxygen and Temperature graph students identify the inverse relationship between oxygen and temperature and how that changes seasonally.	the graph? How high or low do the lines/columns reach? *Reason:* What do the patterns you have identified mean? *Communicate:* How do the factors change over time? Have students identified the factors using label names and amounts.
Episode 3: Assessment	Students are doing a self-assessment using a graph caption scavenger hunt check list. Students check to make sure they explain patterns using words from axis labels, use specific numbers to compare variable amounts, describe changes representative of the whole graph, and state inferences that are specific to the data collected.		
Episode 4: <u>Water Data Analysis Questions</u> CCC: Patterns, Cause & Effect	*Gather Part I:* Students pre-define what their idea of a scientific question is and is not.	*Gather Part I:* Scientific questions are distinguished from other types of questions in that the answers lie in explanations supported by empirical evidence, including evidence gathered by others or through investigation. (http://ngss.nsta.org/Practices.aspx?id=1) Students identify that testable scientific questions can be answered through measurement and observation. Some questions are based on opinion and the	*Gather Part I:* What is meant by asking scientific questions?

SEP: Analyzing and Interpreting Data, Asking Questions Time: 30-45 minutes	*Gather Part II*- Students look at the graphs from episode 3 and create scientific questions the scientists asked that led them to collect those measurements. *Reason:* Students are introduced to independent and dependent variables in a slide show. Students are asked to look at the questions they wrote to determine if their questions included the variables represented on the graph. *Communicate:* Students create 2 testable scientific questions related to the field data they collected. They will use these to create graphs in episode 5.	answers vary based on the person's perception, i.e.., Was the skiing good? Is the food at the restaurant spicy? What is your favorite movie? *Gather Part II:* How does the temperature change throughout the year? What are the highest and lowest temperatures? How much does the temperature vary throughout the year? Does pH change from one site to another along a stream corridor? Does temperature effect oxygen levels? *Reason:* Students need to identify that on graph 1 a question should be asked relating the time of year to temperature. On graph 2, the questions should be related to site location and pH. On graph 3 students would look at year and changing amounts or they may think about the oxygen and temperature relationship. This could be explored further if the temperature was graphed on the x-axis and oxygen was on the y-axis. *Communicate:* Examples include; Does air temperature effect water temperature? How are oxygen and temperature related? Does the weather influence turbidity? Does the percent of algae change with temperature? Questions will depend on how and where measurements were collected.	*Gather Part II:* Does the question incorporate the graph axis labels? *Reason:* What are independent variables? What is a dependent variable dependent upon? How are variables graphed to show a relationship between the factors being measured? *Communicate:* Does the question being asked specify a relationship between dependent and independent variables related to field data collection? Is this a question that can be investigated using observations and measurement?

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Assessment Episode 4	Exit slips are collected to determine if students can write testable scientific questions that incorporate independent and dependent variables that include the field data factors.		
Episode 5: <u>Graphing Environmental Interactions within the Water Body</u> CCC: Cause and Effect, Patterns, Stability and Systems SEP: Analyze and Interpret Data; Construct Explanations Time: 90 minutes 30 min Chart/Graph practice 30 min Individual graph with	*Gather:* Students compile all data collected and organize it into a written chart or computer spreadsheet. Students will be asking questions that can be answered by graphing the data to determine the relationships between the specific river data they collected. *Reason*: Students will select appropriate graphs to showcase relationships between variables that relate to the questions they have written. *Communicate:* Students analyze graphs and interpret the relationship that exists between the variables that they graphed. Students will use CER (claim, evidence, reasoning) to create a slide that includes their question, graph. and analysis. This slide will be presented and	*Gather:* Students will have to arrange and format data on a spreadsheet. They will need to arrange their spreadsheet charts so that the independent variable is set up to go on the x-axis and the dependent variable will be on the y-axis. Student questions reflect this relationship. For example, if they compare two factors…How does temperature affect oxygen? Temperature would be the independent and oxygen would be the dependent. *Reason*: Students learn to interpret graphs, making sure that what the computer graphed matches the question they are asking. *Communicate*: Students recognize how abiotic factors change along the river corridor, either naturally or by human influence. They will then predict how these changes affect the living and nonliving factors within the water ecosystem.	*Gather:* Is the independent variable listed first on the chart, so that the graph will align to the question being asked? *Reason:* Does the graph show labels that represent the selected independent and dependent variable? Does the type of graph chosen represent the data clearly? *Communicate:* How did the observations made about the site area relate to the measurements recorded for the parameters? How did the water parameter measurements change over time or along the river corridor from site to site? (depending on how and when data was collected)

analysis 30 min Presentations	explained to the class.		What was different with the collection times or places that altered the measurements taken? Is the water quality of the water body you tested within Utah standards? If not, where did it not meet standards? For what reasons might the water quality factors be at a harmful level?
Assessment Episode 5	Student graphs and inferences can be used to access their understanding; Review CER (claim, evidence, reasoning) that goes with graph to identify misunderstandings. Formative: Student slide for class presentation is well organized. Question is scientific and testable. Graph matches question, labels are correct. Graph caption explains graph patterns and infers cause and effect relationships as well as the stability and change within the system.		